PROCESS OPTIMIZATION (PRO-OP) REVIEW

Process Optimization Review (PRO-OP)

Fleet Analysis/Vent Gas Emissions Reduction Demonstration Project Final Report

for

Newfield Exploration

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U.S. Environmental Protection Agency, Natural Gas STAR Program

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EPA Natural Gas STAR Program

Study Report

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1. Background

The EPA Natural Gas STAR Program funded a study to quantify the potential opportunities for reducing Methane emissions and increasing production efficiency from one selected Oil & Gas Producer's fleet of assets in the Gulf of Mexico.

2. Scope of Work

The study process was as follows:

1. Newfield Exploration Company (Newfield) was selected as the oil and gas producer in the Gulf of Mexico.

2. Obtain the Natural Gas STAR partner Newfield's management approval and buy-in to the study process objectives.

3. Gather required and available data for the Newfield's producing assets.

4. Analyze this available data from two perspectives:

   A) Quantify methane gas reduction opportunities from reduced venting and flaring of hydrocarbons (methane).

   B) Quantify methane gas savings by using available technology to optimize fuel efficiency and calculate potential natural gas emissions from the reduced fuel gas (methane) consumption.

5. Quantify the potential methane gas savings and GHG emissions, as well as associated cost-benefits to the oil & gas producer.

6. Report the findings, recommendations and potential impact for the fleet of assets.

COMM Engineering provided engineering services to develop the study process and implement an optimization study for Newfield Exploration Company. The study focused on the benefits available to a Natural Gas STAR partner as well as on the potential reductions in methane and GHG emissions.

3. Fleet Description of Producing Assets

Newfield Exploration Company was the selected Natural Gas STAR Program partner for this fleet analysis in the Gulf of Mexico. Newfield's fleet consists of over 50 production facilities. Newfield's average annual production is approximately 235-245 BOE. Thirty-two (32) facilities were selected for the vent gas analysis based upon the opportunity to realize the best optimization results. One hundred thirty-five (135) engines, located on 50 production facilities, were studied in fuel gas optimization analysis.

Fifty three (53) different producing and power generation engine models were analyzed in Newfield Exploration's fleet of assets.

Qty.	Engine Manufacturer	Engine Model
1	Cummins	Unk
1	MK-2	1202
1	White	12G-825
1	Waukesha	145GZU
1	Caterpillar	3306
1	Caterpillar	330651
2	Caterpillar	3306TA
2	Caterpillar	341
1	Waukesha	3521-GU
1	Detroit	371
1	Caterpillar	398
1	John Deere	4-45HF150D
1	Cummins	472023005
1	Waukesha	5108
1	Cummings	6CTA8.3
2	Waukesha	7042G
2	Waukesha	7042-GU
4	Waukesha	7042-GSI
2	Waukesha	7042-L
2	Waukesha	817GU
4	Waukesha	F-1905
2	Waukesha	F-1905G
4	Waukesha	F`905-GU
1	Waukesha	F2895
1	Waukesha	F-3521NA
2	Waukesha	F817-GU
2	Caterpillar	G-398
1	Caterpillar	G398NA
1	Caterpillar	G398TA
2	Waukesha	L5108G
1	Waukesha	L7042GU
1	Waukesha	L-7042NA
1	Waukesha	LRZ
2	Waukesha	P-9390GSI
1	Perkins	U8154391

4. Study Process Description

Potential natural gas reductions were calculated from two areas:

A) UNBURNED HYDROCARBONS – VENT GAS OPTIMIZATION

Reducing venting and flaring sources on typical oil & gas producing facilities, such as storage tanks, heater treater vents, dehydration units and pneumatics using natural gas.

B) BURNED HYDROCARBONS – FUEL GAS OPTIMIZATION AND GHG EMISSIONS REDUCTIONS

Fuel efficiency improvements for natural gas-driven engines/compressors and generators were calculated as well as the estimated methane emissions reductions from the improved combustion efficiency.

4A

Newfield Exploration Company

PRO-OP Review
of
Methane Venting Sources
for
the Gulf of Mexico Facilities

by:

COMM Engineering

1. Introduction
2. Methods Used
3. Results
4. Optimization Techniques
5. Conclusions
6. Appendix A - Flashing losses calculations for Glycol dehydrators and pressure and level controllers

1.0 Introduction

COMM Engineering was contracted by the EPA Gas STAR Program to estimate methane emissions from Newfield Exploration Company's oil and gas production facilities operating in the Gulf of Mexico. The focus of the estimates was hydrocarbon and methane emissions from flashing losses, glycol dehydrators and pressure and level controllers. The PRO-OP Review (Process Optimization Review) described in SPE Paper 93939 was used to implement this project. PRO-OP implementation increases the amount of natural gas injected into the sales pipeline.

PRO-OP is a systematic approach used in production operations to identify opportunities to increase profitability while reducing green house gases (GHGs) such as methane. PRO-OP assesses processes at new and existing facilities with an emphasis on energy efficiency, natural resource conservation and waste minimization. The PRO-OP process uses proven methane reduction methods recommended by the EPA's Gas STAR Best Management Practices (BMP). This methodology can be used in conjunction with a Process Hazards Analysis (PHA) for new facilities and prior to modification of an existing facility.

This report ranks facilities based on methane and total hydrocarbon emissions. The ranking gives Newfield a list of facilities that are candidates for onsite surveys and implementation of optimization techniques. The surveys would include verification of operating parameters, collection of gas and oil samples and direct measurement of vent gas. From this survey data, cost-effective options such as those in the Gas STAR BMPs can be developed to increase efficiency and reduce methane emissions.

2.0 Methods Used

Data collected by Newfield for the Minerals Management Service's 2005 Gulfwide Offshore Activity Data System (GOADS) air emission inventory was used to generate a platform specific inventory of sources. Total hydrocarbon and methane vent volumes for the emission sources listed in Table 3.1 were estimated using actual process and production data. Table 3.1 displays the emission estimation methods used for each emission source type. The supporting calculations for each platform's emissions sources are contained in Appendix A.

The three emission source types listed below were selected because they offered the greatest potential for cost-effective emission reductions from venting sources.

Table 2.1 List of emission sources and estimation method used.

Emission Source	**Estimation Method**
Flashing losses from separators, heater treaters and tanks	Griswold and Ambler Graphical Method
Glycol dehydrators - flash tanks and still column vents	GLYCalc Version 4.0
Natural gas operated pressure and level controllers	Gas STAR factors

Flashing losses from production separators, heater treaters and storage tanks were estimated using the Griswold and Ambler Method (SPE Paper 7175) as recommended in the EPA Gas STAR Lessons Learned document: "Installing Vapor Recovery Units on Crude Oil Storage Tanks" (www.epa.gov/gasstar). This graphical method allows the user to estimate the amount of gas liberated from the pressure drop between the storage tanks and the pressure vessels upstream of the tanks. The method yields a gas-to-oil (GOR) ratio based the oil's API gravity and the pressure drop. This method includes a range of oil API gravities of 30 to 40 and pressure drops from 10 to 80 pounds per inch gage (psig).

The Griswold and Ambler method estimates a terminal flash between a pressure vessel and an atmospheric storage tank. To estimate the flash for facilities with more than one stage of flash vented (e.g., heater treater flash to atmosphere and storage tank flash to atmosphere), the sum of the two pressure drops was used to determine the total flash.

For processes with pressure drops greater than 80 psig, the GOR corresponding to the 80 psig pressure drop was used. This means that the amount of flash gas was greater than estimated. Direct measurement should be used where the company wants to verify the estimated volumes.

GLYCalc Version 4.0 was used to estimate glycol dehydrator emissions. GLYCalc calculates natural gas venting from the flash tank (i.e., gas-condensate-glycol separator) and the still column vent. A typical inlet natural gas analysis was used using site operating parameters. None of the glycol dehydrators in the survey were equipped with condensers to recover liquids in the still column vent emissions. To estimate the potential amount of oil recovery, the GLYCalc runs calculated the still column vent emissions based on an atmospheric condenser operating. Based on GLYCalc, liberated flash gas (flash tanks and condenser off gas) was similar in chemical makeup to the dehydrated gas. The uncontrolled still column vent off gas had a greater BTU value than sales gas and more hydrocarbon liquids recoverable at atmospheric conditions.

EPA Gas STAR and manufacturer data were used to estimate releases from pressure and level controllers using natural gas. The EPA Gas STAR Lessons Learned document, "Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry" contains the emissions data.

Thirty-two facilities included in unburned hydrocarbon study are listed in Table 2.2.

Table 2.2.
List of facilities with methane venting emissions estimated.

East Cameron (EC) 33 A	High Island (HI) 521 B	Ship Shoal (SS) 157 A
East Cameron (EC) 47 JP	High Island (HI) 531A	South Timbalier (ST) 148 B
East Cameron (EC) 48 I	High Island (HI) 536 C-Aux	South Timbalier (ST) 148 D
East Cameron (EC) 286 A	High Island (HI) 537 B	Vermilion (VR) 215 CF
Eugene Island (EI) 182 A	High Island (HI) 561 A	Vermilion (VR) 398 A
Eugene Island (EI) 184 A	Main Pass (MP) 138 B	West Cameron (WC) 73 A
Eugene Island (EI) 217 B	South Marsh (SM) 49 A-Qtr	West Cameron (WC) 192 A
Ewing (EW) 947 A	South Marsh (SM) 141 A	West Cameron (WC) 192 B
High Island (HI) 471 A	South Marsh (SM) 160 A	West Cameron (WC) 618 A
High Island (HI) 474 A	Ship Shoal (SS) 58 A	West Cameron (WC) 648 A
High Island (HI) 489 B	Ship Shoal (SS) 69 A	West Delta (WD) 152 A

3.0 Results

The results of the methane and total hydrocarbon emission estimates are given in Tables 3.1 through 3.5. The tables display estimates of the total methane and hydrocarbons vented by the platforms and give estimates for each of the emission source types (flash gas, glycol dehydrators and pressure/level controllers). Based on the estimated total volume and dollar value of vent gas, several facilities warrant further investigation.

Total estimated methane emissions were 405,938 MSCF per year for the thirty-two platforms' three emission sources types included.

Twenty facilities had estimated total methane venting (flash, glycol dehydrators and pressure/level controllers) greater than 5000 MSCF per year. The range in total methane venting was 76.7 MSCF per year to 37,388 MSCF per year.

Fourteen facilities had estimated methane flash losses (i.e., separators, heater treater and storage tanks) greater than 8000 MSCF per year. The range for methane from flashing sources losses was 0 to 18,615.0 MSCF per year.

Glycol dehydrators' had methane emissions from flash tanks and still column vent ranging from 32.9 MSCF per year to 10,085 MSCF per year. Six facilities had methane venting greater than 2000 MSCF per year.

Pressure and level controllers using natural gas had methane estimates of 0 to 18,000 MSCF per year. Fifteen facilities had methane estimates greater than 1,600 MSCF per year from pressure and level controllers.

Table 3.1 Estimated Total Hydrocarbon and Methane Losses for Venting Sources.

Facility	Oil Prod (BOPD)	Gas Prod (MSCFD)	Griswold & Ambler Flash (MSCFD)	Dehydrator (Yes/No)	Dehydrator Flash Gas (MSCFD)	Dehydrator Condenser (BOPD)	Dehydrator Condenser Vent	Press & Level Controllers (MSCFD)	Total Routine Vent Gas (MSCFD)	Total Vent Methane Content1 (MSCF/Yr)	Total Vent Gas1 (MMBUT/Yr)
SS 58 A	1000	7.037	102	Yes	0	0	14.1	1.3	117.4	37388.8	74777.6
VR 398 A	600	23	65.4	Yes	10.49	0.17	0.12	29.8	105.8	29824.3	59648.5
MP 138 B	741	2	54.1	Yes	2.42	0.02	0.04	47	103.6	27743.3	55486.6
VR 215 CF	1242	0.801	60.9	No	0	0	0	32.7	93.6	26827.5	53655
SS 69 A	1100	3	82.5	Yes	1.78	0.04	0.01	0	84.3	28197.1	56394.1
EW 947 A	450	2.25	44.6	No	0	0	0	39.4	84	22608.1	45216.2
SM 160 A	775	1	54.3	No	0	0	0	26.9	81.2	23487.8	46975.5
EI 182 A	900	5.247	80.1	No	0	0	0	0	80.1	27043.8	54087.5
HI 536 C-Aux	900	2.4	49.5	Yes	1.17	0.03	0.011	21.2	71.9	21001.2	42002.4
EI 217 B	700	8	68.6	No	0	0	0	1.4	70	23429.4	46858.7
HI 489 B	864	17.837	62.2	Yes	5.64	0.19	0.11	0	68	22102.1	44204.2
WC 192 A	154	2.6	16.9	No	0	0	0	39	55.9	13179.3	26358.5
WD 152 A	560	1.59	48.2	No	0	0.01	1.9	0	50.1	16273.6	32547.1
HI 474 A	750	0.8	48	Yes	0.04	0.01	0.014	0	48.1	16216.4	32432.7
EI 184 A	500	5.052	45	No	0	0	0	0	45	15193.2	30386.3
SS 157 A	340	5.78	18.7	No	0	0	0	23	41.7	10721	21441.9
ST 148 D	180	9.5	19.8	No	0	0	0	13.4	33.2	9252.8	18505.5
WC 73 A	335	30	0	Yes	30.48	0.04	0.2	0.5	31.2	5974.9	11949.7
ST 148 B	211	3.5	19	No	0	0	0	10.3	29.3	8388.6	16777.2
WC 192 B	8	2.3	0.6	No	0	0	0	25.7	26.3	5127.4	10254.7
SM 141 A	6	15.5	0.7	No	0	0	0	18.3	19	3743.1	7486.2
EC 286 A	2	0.7	0.2	No	0	0	0	16.3	16.5	3191	6382
HI 537 B	108	17.7	0	Yes	7.56	0.11	0.08	4.9	12.5	2403	4806
HI 531A	550	3.5	0	No	2.45	0.05	0.03	7.7	10.2	1475.5	2951
WD 23 #3	200	12	0	Yes	6.624	0.24	0.2	0	6.8	1307.2	2614.4
HI 561 A	48	0.22	4.3	Yes	0.14	0	0.002	0	4.4	1479	2958
SM 49 A-Qtr	28	7.2	0	Yes	3.82	0.07	0.06	0.01	3.9	745.4	1490.8
EC 47 JP	27	3.703	2.1	No	0	0	0	0	2.1	709	1418
EC 33 A	12	2.034	1.7	No	0	0	0	0	1.7	574	1147.9
HI 471 A	0	1.5	0	Yes	0.76	0.03	0.01	0	0.8	147.6	295.1
HI 521 B	2	8	0.2	No	0	0	0	0.2	0.4	105.9	211.7
EC 48 I	0	1	0	No	0	0	0	0.4	0.4	76.7	153.3
				Total	73.374	1.01	16.89	359.41	1399.4	405938	811874.3

[1]Based on flash gas with an average of 1850 BTU/SCF. Glycol dehydrator vent gas with average of 1050 BTU/SCF. Average methane content of 50% by volume.

Table 3.2. Estimated Value of Total Amount of Hydrocarbon Losses From Flashing, Dehydrators and Pressure and Levels.

Facility	Oil Prod (BOPD)	Gas Prod (MSCFD)	Dehydrator Condenser (BOPD)	Total Routine Vent Gas (MSCFD)	Total Vent Gas Energy Content[1] (MMBTU/Yr)	Annual Value[2]
SS 58 A	1000	7.037	0	117.4	74777.6	$373,888
VR 398 A	600	23	0.17	105.8	59648.5	$298,251
SS 69 A	1100	3	0.04	84.3	56394.1	$281,973
MP 138 B	741	2	0.02	103.6	55486.6	$277,434
EI 182 A	900	5.247	0	80.1	54087.5	$270,438
VR 215 CF	1242	0.801	0	93.6	53655	$268,275
SM 160 A	775	1	0	81.2	46975.5	$234,878
EI 217 B	700	8	0	70	46858.7	$234,294
EW 947 A	450	2.25	0	84	45216.2	$226,081
HI 489 B	864	17.837	0.19	68	44204.2	$221,031
HI 536 C-Aux	900	2.4	0.03	71.9	42002.4	$210,014
WD 152 A	560	1.59	0.01	50.1	32547.1	$162,736
HI 474 A	750	0.8	0.01	48.1	32432.7	$162,164
EI 184 A	500	5.052	0	45	30386.3	$151,932
WC 192 A	154	2.6	0	55.9	26358.5	$131,793
SS 157 A	340	5.78	0	41.7	21441.9	$107,210
ST 148 D	180	9.5	0	33.2	18505.5	$92,528
ST 148 B	211	3.5	0	29.3	16777.2	$83,886
WC 73 A	335	30	0.04	31.2	11949.7	$59,751
WC 192 B	8	2.3	0	26.3	10254.7	$51,274
SM 141 A	6	15.5	0	19	7486.2	$37,431
EC 286 A	2	0.7	0	16.5	6382	$31,910
HI 537 B	108	17.7	0.11	12.5	4806	$24,036
HI 561 A	48	0.22	0	4.4	2958	$14,790
HI 531A	550	3.5	0.05	10.2	2951	$14,758
WD 23#3	200	12	0.24	6.8	2614.4	$13,084
SM 49 A-Qtr	28	7.2	0.07	3.9	1490.8	$7,458
EC 47 JP	27	3.703	0	2.1	1418	$7,090
EC 33 A	12	2.034	0	1.7	1147.9	$5,740
HI 471 A	0	1.5	0.03	0.8	295.1	$1,477
HI 521 B	2	8	0	0.4	211.7	$1,059
EC 48 I	0	1	0	0.4	153.3	$767
		Total	1.01	1399.4	811874.3	$4,059,422

[1]Based on flash gas with an average 1850 BTU/SCF. Glycol dehydrator vent gas with average 1050 BTU/SCF.

[2]Based on gas value of $5.00/MMBTU for vent gas and $50/barrel for oil recovered by condenser.

Table 3.3. Estimated Methane and Hydrocarbon Losses from Flashing Losses Using Griswold and Ambler Graphical Method and Value of Gas Vented.

Facility	Avg. Oil Production (BOPD)	Pressure Differential (psig)	Total Flash GOR[1] (scf/bbl)	Total Flash MSCFD	Total Flash Value per Year based on $5/MMBTU[2]	Flash Methane MSCF/Yr[3]
SS 58 A	1000	110	102	102	$344,378	18,615.0
SS 69 A	1100	65	75	82.5	$278,541	15,056.3
EI 182 A	900	90	89	80.1	$270,438	14,618.3
EI 217 B	700	95	98	68.6	$231,611	12,519.5
HI 536 C-Aux	900	70	73	65.7	$221,820	11,990.3
VR 398 A	600	100	109	65.4	$220,807	11,935.5
HI 489 B	864	50	72	62.2	$210,003	11,351.5
VR 215 CF	1242	32	49	60.9	$205,614	11,114.3
SM 160 A	775	110	70	54.3	$183,330	9,909.8
MP 138 B	741	120	73	54.1	$182,655	9,873.3
WD 152 A	560	100	86	48.2	$162,735	8,796.5
HI 474 A	750	42	64	48	$162,060	8,760.0
EI 184 A	500	85	90	45	$151,931	8,212.5
EW 947 A	450	100	99	44.6	$150,581	8,139.5
ST 148 D	180	140	110	19.8	$66,850	3,613.5
ST 148 B	211	105	90	19	$64,149	3,467.5
SS 157 A	340	50	55	18.7	$63,136	3,412.8
WC 192 A	154	150	110	16.9	$57,059	3,084.3
HI 561 A	48	80	89	4.3	$14,518	784.8
EC 47 JP	30	60	70	2.1	$7,090	383.3
EC 33 A	15	180	110	1.7	$5,740	310.3
SM 141 A	6	190	110	0.7	$2,363	127.8
WC 192 B	10	42	64	0.6	$2,026	109.5
EC 286 A	2	130	110	0.2	$675	36.5
HI 521 B	2	220	110	0.2	$675	36.5
EC 48 I	0	280	110	0	0	0.0
			Total	965.8	$3,260,782	176,259.1

[1]Flash GOR greater than specified for facilities with pressure differential greater than 80 psig.

[2]Based on $5.00 per MMBTU and an average of 1850 BTU/scf for flash gas.

[3]Based on assumed methane volume of 50% for tank flash gas.

Table 3.4. Estimated Hydrocarbon Losses for Glycol Dehydrators.

Facility	Gas Production (MSCFD)	Dehydrator Flash Gas (MSCFD)	Dehydrator Condenser (BOPD)	Dehydrator Condenser Vent (MSCFD)	Total Dehydrator Vent Gas (MSCFD)	Methane Content of Vent Gas[1] (MSCF/Yr)	Total Vent Gas Energy Content[2] (MMBTU/Yr)	Annual Value[3]
WC 73 A	30	30.48	0.04	0.2	30.7	10085	11765.8	$59,559
SS 58 A	7.037	None	0	14.1	14.1	4631.9	5403.8	$27,019
VR 398 A	23	10.49	0.17	0.12	10.6	3482.1	4062.5	$23,415
HI 537 B	17.7	7.56	0.11	0.1	7.7	2529.5	2951	$16,763
HI 489 B	17.837	5.64	0.19	0.11	5.8	1905.3	2222.9	$14,582
WD 23#3	12	6.624	0.24	0.2	6.8	2233.8	2606.1	$13,031
SM 49 A-Qtr	7.2	3.82	0.07	0.06	3.9	1281.2	1494.7	$8,751
HI 531A	3.5	2.45	0.05	0.03	2.5	821.3	958.1	$5,703
MP 138 B	2	2.42	0.02	0.04	2.5	821.3	958.1	$5,156
SS 69 A	3	1.78	0.04	0.01	1.8	591.3	689.9	$4,180
HI 536 C-Aux	2.4	1.17	0.03	0.01	1.2	394.2	459.9	$2,847
HI 471 A	1.5	0.76	0.03	0.01	0.8	262.8	306.6	$2,081
HI 474 A	0.8	0.04	0.01	0.014	0.1	32.9	38.3	$374
HI 561 A	0.22	0.14	0	0.002	0.1	32.9	38.3	$192
			Total	15	88.6	29105.5	33956	$183,653

[1]Based on glycol dehydrator flash tank and condenser off gas with average of 90% by volume methane.

[2]Based on glycol dehydrator flash tank and condenser off gas with average of 1050 BTU/SCF.

[3]Based on gas value of $5.00/MMBTU and $50/barrel for oil recovered by condenser.

Table 3.5. Estimated Hydrocarbon and Methane Losses for Pressure and Level Controllers.

Facility	Oil Prod (BOPD)	Gas Prod (MSCFD)	Number of Controllers Using Natural Gas	Total Venting Volume (MSCFD)	Methane Content of Vent Gas[1] (MSCF/Yr)	Total Vent Gas Energy Content[2] (MMBTU/Yr)	Annual Value[3]
MP 138 B	741	2	50	47	15439.5	18012.8	$90,064
EW 947 A	450	2.25	56	39.4	12942.9	15100.1	$75,501
WC 192 A	154	2.6	55	39	12811.5	14946.8	$74,734
VR 215 CF	1242	0.801	37	32.7	10742	12532.3	$62,662
VR 398 A	600	23	33	29.8	9789.3	11420.9	$57,105
SM 160 A	775	1	28	26.9	8836.7	10309.4	$51,547
WC 192 B	8	2.3	33	25.7	8442.5	9849.5	$49,248
SS 157 A	340	5.78	24	23	7555.5	8814.8	$44,074
HI 536 C-Aux	900	2.4	48	21.2	6964.2	8124.9	$40,625
SM 141 A	6	15.5	21	18.3	6011.6	7013.5	$35,068
EC 286 A	2	0.7	17	16.3	5354.6	6247	$31,235
ST 148 D	180	9.5	14	13.4	4401.9	5135.6	$25,678
ST 148 B	211	3.5	44	10.3	3383.6	3947.5	$19,738
HI 531A	550	3.5	19	7.7	2529.5	2951	$14,755
HI 537 B	108	17.7	18	4.9	1609.7	1877.9	$9,390
EI 217 B	700	8	44	1.4	459.9	536.6	$2,683
SS 58 A	1000	7.037	73	1.3	427.1	498.2	$2,491
WC 73 A	335	30	35	0.5	164.3	191.6	$958
EC 48 I	0	1	14	0.4	131.4	153.3	$767
HI 521 B	2	8	42	0.2	65.7	76.7	$384
SM 49 A-Qtr	28	7.2	3	0.01	3.3	3.8	$19
		Total	708	359.41	118066.7	137744.2	$688,726

[1]Based on fuel gas with average of 1050 BTU/SCF.

[2]Based on gas value of $5.00/MMBTU for vent gas.

4.0. Optimization Techniques

Below are optimization techniques to implement for venting sources covered by this project.

Table 4.1 Optimization Techniques for the Emission Sources Included.

Process/ Emission Source	Measurement Technique	Optimization Technique to Reduce Venting Emissions
Separator and Heater Treater Flash	1. Measure flow with thermal mass flow or ultrasonic meter 2. Measure flash from pressurized oil sample	1. Minimize operating pressure of separators 2. Route flash gas to compressor
Oil Storage Tank Flash	1. Measure flow with thermal mass flow or ultrasonic meter 2. Measure flash from pressurized oil sample	1. Install vapor recovery system to recover vent gases
Glycol Dehydrator Still Column Vent	1. Direct measurement - thermal mass flow or ultrasonic meter 2. GLYCalc with site specific gas analysis	1. Install condenser or vapor recovery for still column vent 2. Optimize glycol circulation rates
Glycol Dehydrator Flash Tanks	1. Direct measurement - thermal mass flow or ultrasonic meter 2. GLYCalc with site specific gas analysis	1. Route gas to fuel system 2. Install vapor recovery or route to suction of compressor
Pneumatics	None	1. Install low bleed pneumatics 2. Use compressed air

The steps to follow to optimize the processes include the following:

1. Conduct site visits to targeted facilities to measure and further quantify emissions.
2. Recalculate emissions and vent gas dollar value based on site surveys.
3. Determine costs for implementing optimization techniques and payout.
4. Decide optimization techniques to implement.
5. Implement optimization.
6. Determine emissions and money saved after optimization.
7. Report emission reductions to EPA Gas STAR program.

4B

Newfield Exploration Company

PRO-OP Review
of
Fuel Gas Optimization
and
Methane Emissions Reductions
for
the Gulf of Mexico

by:

ControlWorx, LLC.

Introduction

ControlWorx, LLC was contracted by COMM Engineering to estimate the fuel gas savings and methane gas emissions from optimizing Newfield's fleet of oil and gas engines (compressors and generators) in the Gulf of Mexico. Engine data was collected and analyzed to determine the annual volume of methane gas that could be sent to the sales gas pipeline if the engines fuel consumption was optimized. The reduction in methane gas emissions, as well as other GHG emissions that result from the optimization of the fuel gas, was also calculated.

The Fleet Asset assessment included the gathering of information from each of Newfield's Gulf of Mexico production facilities. Data was gathered on all the natural gas driven engines. The Process Optimization Review approach (see Appendix B) was used to identify opportunities in production and profitability while reducing green house gases (GHG_s) such as methane.

The information gathered was as follows:

1. Facility name
2. Unit number
3. Type of engine service:
    - Compression or Power Generation
4. Type of engine driver:
    - Natural gas or electric
5. Engine manufacturer
6. Engine model
7. Rated horsepower
8. Average running RPMs
9. Estimated % load or hp
10. Production volumes - Mcfd
11. Average number of starts per year

From this information, the estimated fuel consumption was calculated based upon the manufacturer's specifications for the specific engine's horsepower, running RPMs and estimated percent load on the compressors.

Based upon this information, an estimated fuel reduction percentage was calculated using currently available REMVue technology to improve the engine's efficiency. Using available data from existing installations of this technology by other Oil & Gas STAR Program partners in the Gulf of Mexico, the fuel savings benefit was calculated as well as the estimated actual fuel gas reductions in MCF per day. The reduction in fuel gas saved by reducing the number of starts per year was calculated and included in total fuel gas savings.

Additionally, using the installed base of available data on the actual available run-time improvement from implementing the REMVue technology, the estimated up-time improvement in hours per month was calculated as well as the increased production benefit. The average up-time (run-time) improvement that was used in this analysis was approximately 1% or three hours per month. This improvement has been documented due to lower engine cylinder temperatures, faster starting and reduced maintenance downtimes made possible by the currently available REMVue fuel optimization technology. NOTE: This run-time improvement was quantified for purposes of this analysis, but is not included in the benefits since the study only focused on fuel optimization and methane (GHG) emission reductions. It is included only for reference and future financial analyses.

The methane emissions reductions were estimated based upon the fuel gas consumption reductions and fewer, as well as faster, start times. The total GHG emissions reductions were calculated and are shown in the attached Table 5.0. NOTE: eGHG = the sum of methane emissions multiplied by 21 plus the CO_2 emissions.

Published data from other EPA Natural Gas STAR partners was used to validate these analyses.

Results

The results of the total fuel gas savings and the total greenhouse gas emission reductions for the Newfield fleet are given in Table 5.0 as well as a **PRO-OP** prioritized ranking of the target compressors and generators. See Attachments – Table 5.0 – **Total** and **PRO-OP** target spreadsheets.

Table 5.0 - Total Potential Fuel Gas savings and GHG emissions summary for Newfield's Gulf of Mexico Natural Gas engines.

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Gas Compressors/Gensets

Gas price $5.00 $/Mscf

Uptime 98 %

Facility Name	Unit #	Type of Service Compression / Power Generation	Driver Natural Gas Electric Diesel	Engine Mfc.	Engine Model	Est.% fuel reduction	Fuel Gas Reduction MCFD	Annual Fuel Savings Benefit	Annual Start Gas Reduction MCF	Annual Start Gas Reduction Benefit
HI-471-A	1	Compressor #1	NG	Waukesha	9390	30	**108.7**	$198,374	104.00	$520.00
WD-23	1	Compression #1	NG	Waukesha	P-9390GSI	30	**105.7**	$192,864	100.00	$500.00
WD-23	2	Compression #2	NG	Waukesha	P-9390GSI	30	**105.7**	$192,864	100.00	$500.00
MP-138B	1	Comp-Universal Rental	NG	Waukesha	7042GSI	30	**103.1**	$188,180	100.00	$500.00
HI-521-B	1	Compressor #1	NG	Waukesha	L7042GSI	30	**90.6**	$165,312	104.00	$520.00
HI-489-B	1	Compressor #1	NG	Waukesha	L7042GSI	30	**72.5**	$132,250	104.00	$520.00
EW-947A	1	Compression	NG	Waukesha	7042-GSI	30	**71.7**	$130,872	100.00	$500.00
EC-151A	1	Compression	NG	Caterpillar	G-398	30	**60.4**	$110,208	150.00	$750.00
MP-138B	3	Generator	NG	Waukesha	7042GSI	30	**55.6**	$101,391	100.00	$500.00
HI-474-A	1	Compressor #1	NG	Waukesha	L7042	30	**52.8**	$96,432	104.00	$520.00
WD-152A	1	Compressor #1	NG	Waukesha	7042-L	30	**52.8**	$96,432	104.00	$520.00
WD-152A	2	Compressor #2	NG	Waukesha	7042-L	30	**52.8**	$96,432	100.00	$500.00
WC-618	1	Compressor #1	NG	Waukesha	3521GSI	30	**49.8**	$90,922	104.00	$520.00
EI-184 A	2	Comp-Universal Rental	NG	CAT	G3516TALE	21	**47.8**	$87,155	104.00	$520.00
EI-184A	1	Gas Gen #1	NG	Waukesha	7042-G	22	**47.2**	$86,129	104.00	$520.00
EC-48C	1	Compressor #1	NG	CAT	G3512LE	21	**46.8**	$85,446	104.00	$520.00
BA-23A	1	Comp-Universal Rental	NG	Waukesha	7042	30	**45.3**	$82,656	104.00	$520.00
SMI-49E	1	Compressor #1	NG	WAUK	P9390	30	**45.3**	$82,656	104.00	$520.00
EI-251A	1	Gas Gen #1	NG	Waukesha	7042	30	**42.3**	$77,146	104.00	$520.00
EC-192A	1	Compressor #1	NG	CAT	G398	21	**37.5**	$68,357	104.00	$520.00
WC-192A	1	Compression	NG	CAT	G398	21	**37.5**	$68,357	40.00	$200.00
EC-33A	1	Compressor #1	NG	Waukesha	L7042GU	22	**37.3**	$67,997	104.00	$520.00
EI-217 B	1	Compressor #1	NG	WAUK	L7042GU	22	**35.5**	$64,824	104.00	$520.00
MP-138B	1	Gas Gen #1	NG	Waukesha	F3521GSI	30	**34.0**	$61,992	104.00	$520.00
S.T148-D	1	Compression	NG	Cat	G398NA	21	**32.8**	$59,812	70.00	$350.00
HI-537	1	Compressor #1	NG	Waukesha	7042	22	**32.0**	$58,477	104.00	$520.00
VER-215 A/CF	1	Compressor #1	NG	WAUK	L7042GU	22	**31.8**	$58,024	104.00	$520.00
WD-23	1	Generator #1	NG	Waukesha	F-3521NA	30	**30.9**	$56,344	100.00	$500.00
SS-157A	1	Compression	NG	Waukesha	5108	22	**30.3**	$55,304	100.00	$500.00
EC-192B	1	Compressor #1	NG	WAUK	L7042GU	22	**29.8**	$54,398	104.00	$520.00
HI-537	2	Compressor #2	NG	Waukesha	7042	22	**29.8**	$54,398	104.00	$520.00
EI-182 A	2	Comp-Universal Rental	NG	Cat	G398TA	21	**29.3**	$53,404	100.00	$500.00
WD-152A	4	Generator #1	NG	Waukesha	7042-GU	30	**28.3**	$51,660	70.00	$350.00
HI-531	1	Comp UCI Rental	NG	CAT	G-398	21	**25.8**	$46,995	104.00	$520.00
WC-192A	2	Compression	NG	Waukesha	L7042GU	22	**24.8**	$45,331	200.00	$1,000.00
WC-192-B	1	Compression	NG	Waukesha	L7042GU	22	**24.8**	$45,331	200.00	$1,000.00
WC-427A	1	Compressor #1	NG	Waukesha	5790	22	**23.8**	$43,518	104.00	$520.00
WC-522	1	Comp_Hanover Rental	NG	CAT	G398	21	**23.4**	$42,723	104.00	$520.00
VR-398	1	Gas Gen #1	NG	Waukesha	3521GSI	30	**22.6**	$41,328	104.00	$520.00
WD-24	1	Compression	NG	Waukesha	L-7042NA	30	**22.6**	$41,328	100.00	$500.00
SS-69	2	Generator #2	NG	Waukesha	L5108G	23	**23.7**	$43,207	100.00	$500.00
EW-947A	1	Generator #1	NG	Waukesha	7042G	23	**21.0**	$38,406	100.00	$500.00
HI-471-A	1	Gas Gen#1	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
SMI-147	1	Gas Gen #1	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
SMI-147	2	Gas Gen #2	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
SMI-160	1	Gas Gen #1	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
ST-148E	1	Comp_Hanover Rental	NG	Waukesha	3521-GU	23	**21.0**	$38,406	70.00	$350.00
BA-21	2	Comp_Hanover Rental	NG	CAT	398	23	**21.0**	$38,406	104.00	$520.00
EC-286A	1	Gas Gen #1	NG	Waukesha	3712GU	24	**20.9**	$38,065	104.00	$520.00
SS-58A	1	Compression	NG	Waukesha	F2895	20	**17.6**	$32,144	70.00	$350.00
WC-648	1	Compressor #1	NG	WHITE	8GTL 825	10	**17.6**	$32,144	104.00	$520.00
S.T.148-B	1	Compression	NG	CAT.	398	21	**16.6**	$30,333	70.00	$350.00
ST-148B	1	Comp_Hanover Rental	NG	CAT	398	21	**16.4**	$29,906	104.00	$520.00

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Gas Compress

Facility Name	Est.uptime impr'ment hr / month	Increased Production Benefit	Rated HP	Est % Load or HP	Rated RPM	Avg. Running RPM	Prod. Volume MMCFD	Prod. KW	Avg # Starts/ year	O2 %	Est.CO2 Reduction Tons/yr	Unburned H/C Tons/yr	Total eCO2 (GHG) Benefit Tons/yr
HI-471-A	3	$11,250	1642	1440	1000	600	1.5		52	0.2	2301	461	11972
WD-23	3	$0	1950	1400	900	1000			50	0.2	2237	448	11639
WD-23	3	$0	1950	1400	900	1000			50	0.2	2237	448	11639
MP-138B	3	$0	1472	1366	1200	1200			50	0.2	2183	437	11358
HI-521-B	3	$60,000	1478	1200	1200	1160	8	8.0 MMCF	52	0.2	1918	384	9984
HI-489-B	3	$36,750	1232	960	1000	810	4.9	4.9MMCF	52	0.2	1534	185	5429
EW-947A	3	$0	1232	950	1000	1000			50	0.2	1518	304	7912
EC-151A	2	$47,500	1200	800	1200	950	9.5		75	0.3	1278	11	1513
MP-138B	3	$0	1472	736	1200	1200		500.00	50	0.2	1176	236	6139
HI-474-A	3	$7,500	896	700	1000	800	1		52	0.2	1119	225	5842
WD-152A	2	$18,500	896	700	1000	900	3.70		52	0.2	1119	225	5842
WD-152A	3	$27,750	896	700	1000	900	3.70		50	0.2	1119	225	5841
WC-618	3	$7,613	840	660	1200	750	1.015		52	0.2	1055	212	5511
EI-184 A	2	$23,500	1200	1020	1800	1400	4.70		52	9	1011	4	1097
EI-184A	3	$22,500	1024	950	1200	1000	3	800kw	52	0.2	999	305	7394
EC-48C	2	$5,000	1200	1000	1200	1000	1.00		52	9	991	4	1077
BA-23A	3	$7,500	818	600	900	900	1.00		52	0.2	959	193	5014
SMI-49E	3	$43,500	1486	600	1000	1000	5.80		52	0.2	959	193	5014
EI-251A	3	$0	818	560	900	900		400kw	52	0.2	895	180	4683
EC-192A	2	$47,500	1200	800	1200	950	9.5		52	0.3	793	10	1009
WC-192A	2	$5,750	1200	800	1200	950	1.15		20	0.4	793	9	983
EC-33A	3	$7,500	818	750	1000	900	1.00		52	0.2	789	241	5847
EI-217 B	3	$20,250	840	715	1000	1000	2.70		52	0.2	752	230	5576
MP-138B	3	$0	736	450	1200	1200			52	0.2	719	145	3771
S.T148-D	2	$1,500	1200	700	700	800	0.30		35	0.3	694	9	874
HI-537	3	$57,990	818	645	1000	833	7.732		52	0.2	678	207	5034
VER-215 A/CF	3	$16,500	810	640	1000	1000	2.20		52	0.2	673	206	4996
WD-23	3	$0	600	409	900	900		275.00	50	0.2	654	132	3430
SS-157A	3	$0	818	610	1000	1000			50	0.2	642	196	4762
EC-192B	3	$7,500	818	600	900	900	1.00		52	0.2	631	193	4686
HI-537	3	$63,870	818	600	1000	780	8.516		52	0.2	631	193	4686
EI-182 A	2	$5,000	1200	625	1200	900	1.00		50	0.3	619	8	796
WD-152A	3	$0	750	375	900	900			35	0.2	599	121	3136
HI-531	2	$20,800	625	550	1200	1090	4.16		52	0.3	545	8	707
WC-192A	3	$12,000	818	500	1000	800	1.60		100	0.2	526	163	3953
WC-192-B	3	$12,000	818	500	1000	800	1.60		100	0.2	526	163	3953
WC-427A	3	$12,240	604	480	1000	812	1.63		52	0.2	505	155	3758
WC-522	2	$7,320	650	500	1200	1055	1.46		52	0.3	496	7	647
VR-398	3	$0	580	300	1200	900			52	0.2	479	98	2529
WD-24	3	$0	895	300	1000	1000		200.00	50	0.2	479	98	2527
SS-69	3	$0	818	450	900	900			50	0.2	501	145	3552
EW-947A	3	$0	818	400	900	900		300.00	50	0.2	446	129	3162
HI-471-A	3	$0	818	400	900	900			52	0.2	446	129	3163
SMI-147	3	$0	818	400	900	900			52	0.2	446	129	3163
SMI-147	3	$0	818	400	900	900			52	0.2	446	129	3163
SMI-160	3	$0	818	400	900	900			52	0.2	446	129	3163
ST-148E	3	$0	600	400	1200	1140			35	0.2	446	129	3149
BA-21	2	$5,000	430	400	1200	1000	1.00		52	0.3	446	6	575
EC-286A	1	$2,500	423	375	900	900	1.00		52	0.4	442	123	3017
SS-58A	1	$2,500	425	400	1000	700	1.00		35	0.4	1864	79	3514
WC-648	4	$32,000	1100	900	900	825	3.2		52	9	373	9	555
S.T.148-B	3	$4,500	550	355	1200	808	0.60		35	0.3	352	5	458
ST-148B	2	$0	550	350	1200	1200			52	0.3	347	6	466

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Facility Name	Unit #	Type of Service Compression / Power Generation	Driver Natural Gas Electric Diesel	Engine Mfc.	Engine Model	Est.% fuel reduction	Fuel Gas Reduction MCFD	Annual Fuel Savings Benefit	Annual Start Gas Reduction MCF	Annual Start Gas Reduction Benefit
EI-251 A	1	Compressor #1	NG	Cooper	GMVH-12	7	**16.3**	$29,687	104.00	$520.00
HI-355-A	1	Compressor #1	NG	Cat	398T	21	**16.1**	$29,393	90.00	$450.00
SS-69	1	Compression	NG	White	12G-825	10	**15.7**	$28,572	70.00	$350.00
EI-251 A	1	Comp-Universal Rental	NG	WAUK	F3521 GFI	22	**14.7**	$26,836	104.00	$520.00
EI-198A	4	Ram Pump(rental)	NG	CAT	3406TA	21	**13.8**	$25,207	104.00	$520.00
HI-489-B	1	Gas Gen. #1	NG	Waukesha	L3711G	22	**12.4**	$22,666	104.00	$520.00
EI-198A	1	Gas Gen #1	NG	Waukesha	1905 GW	20	**12.3**	$22,501	104.00	$520.00
SS-157A	1	Generator	NG	Cat	341	21	**11.7**	$21,362	100.00	$500.00
WD-23	2	Generator #2	NG	Waukesha	LRZ	18	**11.6**	$21,168	100.00	$500.00
VR-215A	1	Gas Gen #1	NG	Waukesha	H-2476-G	20	**11.4**	$20,894	104.00	$520.00
HI-536	1	Gas Gen#1	ng	wauk.	H-24	20	**11.0**	$20,090	104.00	$520.00
ST-148D	1	Comp_Hanover Rental	NG	CAT	G398NA	20	**11.0**	$20,090	104.00	$520.00
SMI-17 A	1	Comp_Hanover Rental	NG	CAT	G398TA	21	**10.5**	$19,225	104.00	$520.00
WC-601	2	Comp_Hanover Rental	NG	CAT	379	21	**9.8**	$17,944	104.00	$520.00
HI-561	1	Comp-Universal Rental	NG	CAT	G-379TAW	21	**9.4**	$17,089	40.00	$200.00
EI-172A	1	Gas Gen #1	NG	Waukesha	1905	20	**8.8**	$16,072	104.00	$520.00
EI-217B	1	Gas Gen #1	NG	Waukesha	1905 GR	20	**8.8**	$16,072	104.00	$520.00
WC-601	1	Compressor #1	NG	WHITE	86-825	7	**8.5**	$15,484	104.00	$520.00
EC-47JP	1	Compressor #1	NG	CAT	G342TA	21	**8.2**	$14,953	104.00	$520.00
EC-48I	1	Compressor #1	NG	CAT	G342TA	21	**8.2**	$14,953	104.00	$520.00
EC-49B	1	Compressor #1	NG	CAT	G342TA	21	**8.2**	$14,953	104.00	$520.00
HI-561	1	Gas Gen #1	NG	Waukesha	1905	20	**7.7**	$14,063	52.00	$260.00
WC-639	1	Gas Gen#1	NG	Cat	379TA	21	**7.5**	$13,671	104.00	$520.00
HI-536	1	Compressor #1	ng	Fairbanks	MEP	5	**7.2**	$13,196	104.00	$520.00
HI-561	2	Oil p/l pump #2	NG	Waukesha	F285SGV	20	**6.6**	$12,054	52.00	$260.00
EI-262 B	1	Compressor #1	NG	WAUK	F1197-G	20	**6.5**	$11,813	104.00	$520.00
WC-73A	1	Power Gen #1	NG	Waukesha	F1905GU	22	**6.2**	$11,333	52.00	$260.00
WC-522	1	Gas Gen#1	NG	Waukesha	1197	19	**6.2**	$11,310	104.00	$520.00
EI-262B	1	Gas Gen #1	NG	Waukesha	1197 GU	20	**6.2**	$11,250	104.00	$520.00
HI-561	1	Oil p/l pump #1	NG	Waukesha	F285SGV	20	**5.5**	$10,045	52.00	$260.00
BA A-7B	1	Compressor #1	NG	CAT	3306T	21	**4.7**	$8,545	72.00	$360.00
SMI-141A	1	Gas Gen #1	NG	Cat	342TA	21	**4.7**	$8,545	104.00	$520.00
WC-146	1	Compressor #1	NG	Caterpillar	33065 I	21	**4.7**	$8,545	0.00	$0.00
S.T.148-B	1	Generator	NG	Waukesha	F1905-GU	20	**4.4**	$8,036	70.00	$350.00
SS-354	1	Generator	NG	Waukesha	F1905G	20	**4.4**	$8,036	100.00	$500.00
ST-148B	1	Gas Gen #1	NG	Waukesha	F1905-GU	20	**4.4**	$8,036	104.00	$520.00
ST-148E	1	Gas Gen #1	NG	Waukesha	F1905-GU	20	**4.4**	$8,036	70.00	$350.00
WD-24	1	Generator	NG	Waukesha	F-1905	20	**4.4**	$8,036	104.00	$520.00
WD-24 F-1	1	Gas Gen #1	NG	Waukesha	F-1905	20	**4.4**	$8,036	104.00	$520.00
WD-24 P-1	1	Compressor #1	NG	Waukesha	F-1905	20	**4.4**	$8,036	104.00	$520.00
WD-24 P-1	1	Gas Gen #1	NG	Waukesha	F-1905	20	**4.4**	$8,036	104.00	$520.00
MP-138A	1	Generator #1	NG	Cat	3306TA	21	**3.7**	$6,836	100.00	$500.00
HI-521-B	3	Gas Gen. #3	NG	Waukesha	VRG-330	22	**3.7**	$6,800	300.00	$1,500.00
WC-601	1	Gas Gen#1	NG	Waukesha	1905	20	**3.5**	$6,429	104.00	$520.00
WC-618	1	Gas Gen#1	NG	Waukesha	F1197	19	**3.3**	$6,032	104.00	$520.00
SMI-49Aux	1	Gas Gen #1	NG	Waukesha	817	20	**3.1**	$5,625	104.00	$520.00
SMI-49Aux	3	Gas Gen #3	NG	Waukesha	817	20	**3.1**	$5,625	104.00	$520.00
ST-193A	1	Generator	NG	Waukesha	817GU	18	**2.3**	$4,234	100.00	$500.00
ST-193A	2	Generator	NG	Waukesha	817GU	18	**2.3**	$4,234	100.00	$500.00
VR-156A	1	Gas Gen #1	NG	Waukesha	817	18	**2.3**	$4,234	104.00	$520.00
S.T148-D	1	Generator	NG	Waukesha	F817-GU	20	**2.2**	$4,018	70.00	$350.00
WC-618	2	Gas Gen#2	NG	Waukesha	F817	19	**2.1**	$3,770	104.00	$520.00
ST-148D	1	Gas Gen #1	NG	Waukesha	F817-GU	18	**1.9**	$3,528	104.00	$520.00
EC-286A	2	Gas Gen #2	NG	Waukesha	3712GU		**0.0**	$0	104.00	$520.00
EC-286A	3	Comp-Universal Rental	NG				**0.0**		104.00	$520.00
EC-33A	1	Diesel Gen #1	DIESEL	CAT	3306		**0.0**			$0.00

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Facility Name	Est.uptime impr'ment hr / month	Increased Production Benefit	Rated HP	Est % Load or HP	Rated RPM	Avg. Running RPM	Prod. Volume MMCFD	Prod. KW	Avg # Starts/ year	O2 %	Est.CO2 Reduction Tons/yr	Unburned H/C Tons/yr	Total eCO2 (GHG) Benefit Tons/yr
EI-251 A	4	$142,000	2454	1227	330	320	14.20		52	15	344	20	768
HI-355-A	2	$17,500	530	344	1200	900	3.5		45	0.3	341	5	453
SS-69	4	$10,000	1200	800	1000	700	1.00		35	0.5	331	125	2966
EI-251 A	3	$22,500	738	296	1000	1000	3.00	3.0mmcf	52	0.2	311	96	2334
EI-198A	2	$13,000	325	295	1800	1800	2.60		52	0.2	292	5	399
HI-489-B	1	$625,000	325	250	1200	900	250	250 KW	52	0.4	263	50	1319
EI-198A	1	$0	330	280	1200	1200		200.00	52	0.4	261	56	1439
SS-157A	2	$0	465	250	1400	1400			50	0.3	248	5	344
WD-23	1	$0	336	300	900	900		275.00	50	0.4	246	60	1503
VR-215A	1	$0	348	260	1200	1200		200kw	52	0.4	242	52	1339
HI-536	1	$0	475	250	1800	1800			52	0.4	233	50	1289
ST-148D	2	$0	425	250	1200	1200			52	0.3	233	5	330
SMI-17 A	2	$12,500	550	225	1000	1200	2.50		52	0.3	223	4	315
WC-601	2	$9,500	280	210	1200	850	1.9		52	0.3	208	4	297
HI-561	2	$1,100	325	200	1200	1150	0.22		20	0.3	198	3	258
EI-172A	1	$0	260	200	1200	900		150kw	52	0.4	186	43	1094
EI-217B	1	$0	260	200	1200	1200		150kw	52	0.4	186	41	1040
WC-601	4	$19,000	800	640	900	700	1.9		52	0.5	180	101	2307
EC-47JP	2	$5,000	225	175	1200	1000	1.00		52	0.3	173	4	255
EC-48I	2	$5,000	225	175	1200	1000	1.00		52	0.3	173	4	255
EC-49B	2	$5,000	225	175	1200	1000	1.00		52	0.3	173	4	255
HI-561	1	$0	250	175	1200	1200		250KW	26	0.4	163	35	894
WC-639	2	$0	325	160	1200	900			52	0.3	159	4	237
HI-536	3	$25,500	1350	780	900	780	3.4		52	12	153	8	318
HI-561	1	$0	425	150	1000	1200		45bbls	26	0.4	140	30	769
EI-262 B	1	$7,500	292	147	1800	1400	3.00		52	0.4	137	30	776
WC-73A	2	$0	250	125	1200	1200		20.00	26	0.4	131	25	660
WC-522	1	$0	232	150	900	900		100kw	52	0.4	131	31	782
EI-262B	1	$0	235	140	1800	1800		100kw	52	0.4	131	29	741
HI-561	1	$0	425	125	1000	1200		45bbls	26	0.4	117	25	645
BA A-7B	2	$5,000	145	100	1200	1000	1		36	0.3	99	2	151
SMI-141A	2	$0	200	100	900	900			52	0.3	99	3	164
WC-146	2	$0	145	100	1500	1800	0		0	0.4	99	1	121
S.T.148-B	1	$0	205	100	1200	1200			35	0.4	93	21	528
SS-354	1	$0	208	100	1200	1200			50	0.4	93	21	540
ST-148B	1	$0	208	100	1200	1200			52	0.4	93	21	542
ST-148E	1	$0	205	100	1200	1200			35	0.4	93	21	528
WD-24	1	$0	201	100	1200	1200			52	0.4	93	21	542
WD-24 F-1	1	$0	201	100	1200	1200		200.00	52	0.4	93	21	542
WD-24 P-1	1	$0	201	100	1200	1200		200.00	52	0.4	93	21	542
WD-24 P-1	1	$0	201	100	1200	1200		200.00	52	0.4	93	21	542
MP-138A	2	$0	145	80	1800	1800		120.00	50	0.3	79	3	138
HI-521-B	1	$0	100	75	1200	1200		50KW	150	0.4	79	20	509
WC-601	1	$0	184	80	900	900		250kw	52	0.4	75	18	442
WC-618	1	$0	162	80	900	825			52	0.4	70	18	438
SMI-49Aux	1	$0	122	70	1200	1200			52	0.4	65	16	392
SMI-49Aux	1	$0	122	70	1200	1200			52	0.4	65	16	392
ST-193A	1	$0	108	60	1200	1200			50	0.4	49	14	334
ST-193A	1	$0	108	60	1200	1200			50	0.4	49	14	334
VR-156A	3	$0	122	60	1200	1200			52	0.4	49	14	336
S.T148-D	1	$0	106	50	1200	1200			35	0.4	47	11	279
WC-618	1	$0	108	50	900	825			52	0.4	44	12	290
ST-148D	1	$0	106	50	1200	1200			52	0.4	41	12	287
EC-286A		$0	423	375	900	900	1.00		52	0.4	0	123	2575
EC-286A									52				0
EC-33A									52				0

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Facility Name	Unit #	Type of Service Compression / Power Generation	Driver Natural Gas Electric Diesel	Engine Mfc.	Engine Model	Est.% fuel reduction	Fuel Gas Reduction MCFD	Annual Fuel Savings Benefit	Annual Start Gas Reduction MCF	Annual Start Gas Reduction Benefit
EC-33A	2	Diesel Gen #2	DIESEL	CAT	3306		**0.0**			$0.00
EC-47JP	1	Diesel Gen #1	DIESEL	Cat	3306		**0.0**			$0.00
EC-47JP	2	Diesel Gen #2	DIESEL	Cat	3306					$0.00
EC-48C	1	Diesel Gen #1	DIESEL	Cat	3306					$0.00
EC-48C	2	Diesel Gen #2	DIESEL							$0.00
EC-48H	1	Diesel Gen #1	DIESEL	Cat	3304					$0.00
EC-48I	1	Diesel Gen #1	DIESEL	Cat	3304					$0.00
EC-48I	2	Diesel Gen #2	DIESEL	Cat	3306					$0.00
EC-62A	1	Diesel Gen #1	DIESEL	GM						$0.00
EC-62A	2	Diesel Gen #2	DIESEL	GM						$0.00
EI-172A	2	Diesel Gen #2	DIESEL	Cummings	6CTA8.3-G					$0.00
EI-182 A	1	Compression	Electric	Reliance						$0.00
EI-182 A	3		NG							$0.00
EI-182 A	4		NG							$0.00
EI-182 A	5		NG							$0.00
EI-182A	1	Gas Gen #1	NG	Garrett	Turbine G-15					$0.00
EI-182A	2	Gas Gen #2	NG	Garrett	Turbine G-15					$0.00
EI-182A	3	Gas Gen #3	NG	Garrett	Turbine G-15					$0.00
EI-184 A	1	Compressor #1	NG	CAT	3516TA	21			0.00	$0.00
EI-184A	2	Gas Gen #2	NG	Waukesha	7042-G				104.00	$520.00
EI-184A	3	Diesel Gen #3	DIESEL	Cummings	NT-855 G					$0.00
EI-198A	2	Gas Gen #2	NG	Waukesha	1905 GW				104.00	$520.00
EI-217B	2	Diesel Gen #2	DIESEL	Detroit V	871					$0.00
EI-251A	2	Diesel Gen #2	DIESEL	Waukesha	5792 DU					$0.00
EI-262B	2	Gas Gen #2	NG	Waukesha	1197 GU				104.00	$520.00
EW-947A	2	Generator #2	NG	Waukesha	7042G				100.00	$500.00
HI-355-A	1	Diesel Gen #1	Diesel	Fiat	8061SI1500					$0.00
HI-471-A	2	Gas Gen#2	NG	Waukesha	L7042GU				104.00	$520.00
HI-474-A	2	Gas Gen #2	NG	Waukesha	L3711G				104.00	$520.00
HI-474-A	3	Diesel Gen #3	DIESEL	Waukesha	F2896DS					$0.00
HI-489-B	3	Diesel Gen. #3	Diesel	Waukesha	F2896DSU					$0.00
HI-531	1	Diesel Gen #1	Diesel	Detroit	471					$0.00
HI-531	2	Diesel Gen #2	Diesel	Detroit	471					$0.00
HI-536	2	Gas Gen#2	Diesel	Detroit	16v71					$0.00
HI-537	1	Diesel gen #1	Diesel	Detroit	471					$0.00
HI-537	2	Diesel gen #2	Diesel	Detroit	471					$0.00
HI-537	4	Crane	Diesel	Detroit	471					$0.00
HI-561	1	Air Comp #1	Electric	Quincy	5120					$0.00
HI-561	2	Gas Gen #2	NG	Waukesha	1905				52.00	$260.00
HI-561	2	Air Comp #2	Electric	Quincy	5120					$0.00
MP-138A	2	Generator #2	NG	Cat	3306TA				100.00	$500.00
MP-138A	3	RAM Pump (rental)	NG	Cummins	????					$0.00
MP-138B	2	Gas Gen #2	NG	Waukesha	7042GSI				100.00	$500.00
MP-138B	3	Diesel Gen #3	DIESEL	Waukesha	371					$0.00
MP-138B	4	Generator	DIESEL	Detroit	371					$0.00
S.T.148-B	2	Generator	NG	Waukesha	F1905-GU				70.00	$350.00
S.T148-D	2	Generator	NG	Waukesha	F817-GU				100.00	$500.00
SMI-141A	1	Comp_Hanover Rental	NG							$0.00
SMI-141A	1	Diesel Gen	DIESEL							$0.00
SMI-146A	1	Compressor #1	NG							$0.00
SMI-160	1	Compressor #1	NG							$0.00
SMI-160	2	Gas Gen #2	NG	Waukesha	L7042GU				104.00	$520.00
SMI-49Aux	2	Gas Gen #2	NG	Waukesha	817				104.00	$520.00
SS-157A	2	Generator	NG	Cat	341				100.00	$500.00
SS-354	2	Generator	NG	Waukesha	F1905G				100.00	$500.00
SS-58A	1	Generator	ARE	RENTALS						$0.00

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Facility Name	Est.uptime impr'ment hr / month	Increased Production Benefit	Rated HP	Est % Load or HP	Rated RPM	Avg. Running RPM	Prod. Volume MMCFD	Prod. KW	Avg # Starts/ year	O2 %	Est.CO2 Reduction Tons/yr	Unburned H/C Tons/yr	Total eCO2 (GHG) Benefit Tons/yr
EC-33A									52				0
EC-47JP									52				0
EC-47JP									52				0
EC-48C									52				0
EC-48C									52				0
EC-48H									52				0
EC-48I									52				0
EC-48I									52				0
EC-62A									52				0
EC-62A									52				0
EI-172A			277					150kw	52				0
EI-182 A				600			1.00		50				0
EI-182 A									50				0
EI-182 A									50				0
EI-182 A									75				0
EI-182A								500kw	52				0
EI-182A								500kw	52				0
EI-182A								500kw	52				0
EI-184 A		$0	1000	0		1200	0.00		0	0.3	0	0	0
EI-184A		$0	1024	950	1200	100	3	800kw	52	0.2	0	305	6395
EI-184A			300					200kw	52				0
EI-198A		$0	330	280	1200	1200		200.00	52	0.4	0	56	1178
EI-217B			255					150kw	52				0
EI-251A			621					400kw	52				0
EI-262B		$0	235	140	1800	1800		100kw	52	0.4	0	29	611
EW-947A		$0	818	400	900	900		300.00	50	0.2	0	129	2716
HI-355-A			?	75%		?	65 KW	65 KW	150				0
HI-471-A		$0	818	400	900	900			52	0.2	0	129	2718
HI-474-A		$0	325	275	1000	900			52	0.4	0	55	1158
HI-474-A			650	90%		900			52				0
HI-489-B			650	90%		900		250 KW	52		0	0	0
HI-531				90%		1800			52				0
HI-531				90%		1800			52				0
HI-536						1800			52		0	0	0
HI-537									52				0
HI-537									52				0
HI-537									52				0
HI-561			25			1800			26				0
HI-561		$0	250	175	1200	1200		250KW	26	0.4	0	35	731
HI-561			25			1800			26				0
MP-138A		$0	145	80	1800	1800		120.00	50	0.3	0	3	59
MP-138A			450						50				0
MP-138B		$0	1472	736	1200	1200		500.00	50	0.2	0	236	4963
MP-138B						1800			52				0
MP-138B						1800		50.00	50				0
S.T.148-B		$0	205	100	1200	1200			35	0.4	0	21	434
S.T148-D		$0	106	50	1200	1200			50	0.4	0	12	245
SMI-141A									52				0
SMI-141A									52				0
SMI-146A									52				0
SMI-160									52				0
SMI-160		$0	818	400	900	900			52	0.2	0	129	2718
SMI-49Aux		$0	122	70	1200	1200			52	0.4	0	16	327
SS-157A		$0	465	250	1400	1400			50	0.3	0	5	96
SS-354		$0	208	100	1200	1200			50	0.4	0	21	447
SS-58A									50				0

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Facility Name	Unit #	Type of Service Compression / Power Generation	Driver Natural Gas Electric Diesel	Engine Mfc.	Engine Model	Est.% fuel reduction	Fuel Gas Reduction MCFD	Annual Fuel Savings Benefit	Annual Start Gas Reduction MCF	Annual Start Gas Reduction Benefit
SS-58A	2	C RENTALS								$0.00
SS-58A	3	C RENTALS								$0.00
SS-69	1	Generator #1	NG	Waukesha	L5108G				100.00	$500.00
SS-69	3		NG							$0.00
ST-148B	2	Gas Gen #2	NG	Waukesha	F1905-GU				104.00	$520.00
ST-148D	2	Gas Gen #2	NG	Waukesha	F817-GU				104.00	$520.00
ST-148E	2	Diesel Gen #2	DIESEL	Perkins	U8154391					$0.00
ST-193A	1	Compressor #1	NG							$0.00
VER-156 A	1	Compressor #1	NG	CAT	G3516LEW	21			100.00	$500.00
VR-156A	2	Gas Gen #2	NG	Waukesha	817				104.00	$520.00
VR-215A	2	Gas Gen #2	NG	Waukesha	H-2476-G				104.00	$520.00
VR-398	1	Compressor #1	NG							$0.00
VR-398	2	Gas Gen #2	NG	Waukesha	3521GSI				104.00	$520.00
VR-398	2	Compressor #2	NG							$0.00
VR-407	1	Comp-Universal Rental	NG							$0.00
WC-192A	1	Gas Gen #1	NG	John Deere	4045HF150D					$0.00
WC-192A	2	Diesel Gen #2	Diesel	Cummins	472023005					$0.00
WC-192A	3	Power Gen.	NG	Waukesha	145GZU					$0.00
WC-192A	3	Power Gen.	Diesel	Cat	3306					$0.00
WC-192B	1	Diesel Gen #1	Diesel	Waukesha	145GZU					$0.00
WC-192B	1	Diesel Gen #2	Diesel	Cat	3306					$0.00
WC-522	1	Gas Gen#2	NG	Waukesha	1197				104.00	$520.00
WC-561	1	Gas Gen#1	NG	Waukesha					104.00	$520.00
WC-601	2	Diesel Gen #2	Diesel	Detroit	671					$0.00
WC-639	1	Compressor #1	NG							$0.00
WC-639	2	Diesel Gen #2	Diesel							$0.00
WC-648	1	Gas Gen#1	NG	CAT	G379ASI	22			104.00	$520.00
WC-648	2	Diesel Gen #2	Diesel	CAT	D353					$0.00
WC-73A	2	Power Gen #2	Diesel	Cummings	6CTA8.3					$0.00
WD-152A	1	Turbine Comp.	NG	MK-2	1202					$0.00
WD-152A	5	Generator #2	NG	Waukesha	7042-GU				70.00	$350.00
WD-24 F-1	2	Gas Gen #2	NG	Waukesha	F-1905				104.00	$520.00
WD-24 P-1	2	Gas Gen #2	NG	Waukesha	F-1905				104.00	$520.00
					Totals	**109**	**908,087**	**$4,603,494**	**13,562**	**$67,810**

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Total)

Facility Name	Est.uptime impr'ment hr / month	Increased Production Benefit	Rated HP	Est % Load or HP	Rated RPM	Avg. Running RPM	Prod. Volume MMCFD	Prod. KW	Avg # Starts/ year	O2 %	Est.CO2 Reduction Tons/yr	Unburned H/C Tons/yr	Total eCO2 (GHG) Benefit Tons/yr
SS-58A									52				0
SS-58A									52				0
SS-69		$0	818	450	900	900			50	0.2	0	145	3051
SS-69									50				0
ST-148B		$0	208	100	1200	1200			52	0.4	0	21	449
ST-148D		$0	106	50	1200	1200			52	0.4	0	12	246
ST-148E						1800			35				0
ST-193A									52				0
VER-156 A	3	$0	1085	0		1200			50	9	0	2	42
VR-156A		$0	122	60	1200	1200			52	0.4	0	14	287
VR-215A		$0	348	260	1200	1200		200kw	52	0.4	0	52	1097
VR-398									52		0	0	0
VR-398		$0	580	300	1200	900			52	0.2	0	98	2049
VR-398									52				0
VR-407									52				0
WC-192A						1200			52				0
WC-192A						1200			52				0
WC-192A									100				0
WC-192A							20		50				0
WC-192B						800			52				0
WC-192B									52				0
WC-522		$0	232	150	900	900		100kw	52	0.4	0	31	651
WC-561		$0							52				0
WC-601			70	100%		1800		50KW	52				0
WC-639									52				0
WC-639									52				0
WC-648	2	$0				1120			52	0.3	0	2	44
WC-648			375			1120			52		0	0	0
WC-73A			277	150	1800	1800		20.00	52				0
WD-152A			1202	1300		22000	5.60		35				0
WD-152A		$0	750	375	900	900			35	0.2	0	121	2537
WD-24 F-1		$0	201	100	1200	1200		200.00	52	0.4	0	21	449
WD-24 P-1		$0	201	100	1200	1200		200.00	52	0.4	0	21	449
	Units	**$1,588,183**	**87394**	**54841**	**150530**	**188503**	**423**	**4080**	**10020**	**135**	**54892**	**11561**	**297671**

Table 5.0 - PRO-OP targets for Fuel Gas savings and GHG emissions summary for Newfield's Gulf of Mexico Natural Gas engines.

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Pro-Op Targets)

Gas Compressors/Gensets

Gas price $5.00 $/Mscf

Uptime 98 %

Facility Name	Unit #	Type of Service Compression / Power Generation	Driver Natural Gas Electric Diesel	Engine Mfc.	Engine Model	Est.% fuel reduction	Fuel Gas Reduction MCFD	Annual Fuel Savings Benefit	Annual Start Gas Reduction MCF	Annual Start Gas Reduction Benefit
HI-471-A	1	Compressor #1	NG	Waukesha	9390	30	**108.7**	$198,374	104.00	$520.00
WD-23	1	Compression #1	NG	Waukesha	P-9390GSI	30	**105.7**	$192,864	100.00	$500.00
WD-23	2	Compression #2	NG	Waukesha	P-9390GSI	30	**105.7**	$192,864	100.00	$500.00
MP-138B	1	Comp-Universal Rental	NG	Waukesha	7042GSI	30	**103.1**	$188,180	100.00	$500.00
HI-521-B	1	Compressor #1	NG	Waukesha	L7042GSI	30	**90.6**	$165,312	104.00	$520.00
HI-489-B	1	Compressor #1	NG	Waukesha	L7042GSI	30	**72.5**	$132,250	104.00	$520.00
EW-947A	1	Compression	NG	Waukesha	7042-GSI	30	**71.7**	$130,872	100.00	$500.00
EC-151A	1	Compression	NG	Caterpillar	G-398	30	**60.4**	$110,208	150.00	$750.00
MP-138B	3	Generator	NG	Waukesha	7042GSI	30	**55.6**	$101,391	100.00	$500.00
HI-474-A	1	Compressor #1	NG	Waukesha	L7042	30	**52.8**	$96,432	104.00	$520.00
WD-152A	1	Compressor #1	NG	Waukesha	7042-L	30	**52.8**	$96,432	104.00	$520.00
WD-152A	2	Compressor #2	NG	Waukesha	7042-L	30	**52.8**	$96,432	100.00	$500.00
WC-618	1	Compressor #1	NG	Waukesha	3521GSI	30	**49.8**	$90,922	104.00	$520.00
EI-184 A	2	Comp-Universal Rental	NG	CAT	G3516TALE	21	**47.8**	$87,155	104.00	$520.00
EI-184A	1	Gas Gen #1	NG	Waukesha	7042-G	22	**47.2**	$86,129	104.00	$520.00
EC-48C	1	Compressor #1	NG	CAT	G3512LE	21	**46.8**	$85,446	104.00	$520.00
BA-23A	1	Comp-Universal Rental	NG	Waukesha	7042	30	**45.3**	$82,656	104.00	$520.00
SMI-49E	1	Compressor #1	NG	WAUK	P9390	30	**45.3**	$82,656	104.00	$520.00
EI-251A	1	Gas Gen #1	NG	Waukesha	7042	30	**42.3**	$77,146	104.00	$520.00
EC-192A	1	Compressor #1	NG	CAT	G398	21	**37.5**	$68,357	104.00	$520.00
WC-192A	1	Compression	NG	CAT	G398	21	**37.5**	$68,357	40.00	$200.00
EC-33A	1	Compressor #1	NG	Waukesha	L7042GU	22	**37.3**	$67,997	104.00	$520.00
EI-217 B	1	Compressor #1	NG	WAUK	L7042GU	22	**35.5**	$64,824	104.00	$520.00
MP-138B	1	Gas Gen #1	NG	Waukesha	F3521GSI	30	**34.0**	$61,992	104.00	$520.00
S.T148-D	1	Compression	NG	Cat	G398NA	21	**32.8**	$59,812	70.00	$350.00
HI-537	1	Compressor #1	NG	Waukesha	7042	22	**32.0**	$58,477	104.00	$520.00
VER-215 A/CF	1	Compressor #1	NG	WAUK	L7042GU	22	**31.8**	$58,024	104.00	$520.00
WD-23	1	Generator #1	NG	Waukesha	F-3521NA	30	**30.9**	$56,344	100.00	$500.00
SS-157A	1	Compression	NG	Waukesha	5108	22	**30.3**	$55,304	100.00	$500.00
EC-192B	1	Compressor #1	NG	WAUK	L7042GU	22	**29.8**	$54,398	104.00	$520.00
HI-537	2	Compressor #2	NG	Waukesha	7042	22	**29.8**	$54,398	104.00	$520.00
EI-182 A	2	Comp-Universal Rental	NG	Cat	G398TA	21	**29.3**	$53,404	100.00	$500.00
WD-152A	4	Generator #1	NG	Waukesha	7042-GU	30	**28.3**	$51,660	70.00	$350.00
HI-531	1	Comp UCI Rental	NG	CAT	G-398	21	**25.8**	$46,995	104.00	$520.00
WC-192A	2	Compression	NG	Waukesha	L7042GU	22	**24.8**	$45,331	200.00	$1,000.00
WC-192-B	1	Compression	NG	Waukesha	L7042GU	22	**24.8**	$45,331	200.00	$1,000.00
WC-427A	1	Compressor #1	NG	Waukesha	5790	22	**23.8**	$43,518	104.00	$520.00
WC-522	1	Comp_Hanover Rental	NG	CAT	G398	21	**23.4**	$42,723	104.00	$520.00
VR-398	1	Gas Gen #1	NG	Waukesha	3521GSI	30	**22.6**	$41,328	104.00	$520.00
WD-24	1	Compression	NG	Waukesha	L-7042NA	30	**22.6**	$41,328	100.00	$500.00
SS-69	2	Generator #2	NG	Waukesha	L5108G	23	**23.7**	$43,207	100.00	$500.00
EW-947A	1	Generator #1	NG	Waukesha	7042G	23	**21.0**	$38,406	100.00	$500.00
HI-471-A	1	Gas Gen#1	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
SMI-147	1	Gas Gen #1	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
SMI-147	2	Gas Gen #2	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
SMI-160	1	Gas Gen #1	NG	Waukesha	L7042GU	23	**21.0**	$38,406	104.00	$520.00
ST-148E	1	Comp_Hanover Rental	NG	Waukesha	3521-GU	23	**21.0**	$38,406	70.00	$350.00
BA-21	2	Comp_Hanover Rental	NG	CAT	398	23	**21.0**	$38,406	104.00	$520.00
EC-286A	1	Gas Gen #1	NG	Waukesha	3712GU	24	**20.9**	$38,065	104.00	$520.00
					Totals	**49**	**746,381**	**$3,783,736**	**5,120**	**$25,600**

Table 5.0 - Newfield Fleet Fuel Gas Optimzation and GHG Emissions Summary
(Pro-Op Targets)

Gas Compressi

Facility Name	Est.uptime impr'ment hr / month	Increased Production Benefit	Rated HP	Est % Load or HP	Rated RPM	Avg. Running RPM	Prod. Volume MMCFD	Prod. KW	Avg # Starts/ year	O2 %	Est.CO2 Reduction Tons/yr	Unburned H/C Tons/yr	Total eCO2 (GHG) Benefit Tons/yr
HI-471-A	3	$11,250	1642	1440	1000	600	1.5		52	0.2	2301	461	11972
WD-23	3	$0	1950	1400	900	1000			50	0.2	2237	448	11639
WD-23	3	$0	1950	1400	900	1000			50	0.2	2237	448	11639
MP-138B	3	$0	1472	1366	1200	1200			50	0.2	2183	437	11358
HI-521-B	3	$60,000	1478	1200	1200	1160	8	8.0 MMCF	52	0.2	1918	384	9984
HI-489-B	3	$36,750	1232	960	1000	810	4.9	4.9MMCF	52	0.2	1534	185	5429
EW-947A	3	$0	1232	950	1000	1000			50	0.2	1518	304	7912
EC-151A	2	$47,500	1200	800	1200	950	9.5		75	0.3	1278	11	1513
MP-138B	3	$0	1472	736	1200	1200		500.00	50	0.2	1176	236	6139
HI-474-A	3	$7,500	896	700	1000	800	1		52	0.2	1119	225	5842
WD-152A	2	$18,500	896	700	1000	900	3.70		52	0.2	1119	225	5842
WD-152A	3	$27,750	896	700	1000	900	3.70		50	0.2	1119	225	5841
WC-618	3	$7,613	840	660	1200	750	1.015		52	0.2	1055	212	5511
EI-184 A	2	$23,500	1200	1020	1800	1400	4.70		52	9	1011	4	1097
EI-184A	3	$22,500	1024	950	1200	1000	3	800kw	52	0.2	999	305	7394
EC-48C	2	$5,000	1200	1000	1200	1000	1.00		52	9	991	4	1077
BA-23A	3	$7,500	818	600	900	900	1.00		52	0.2	959	193	5014
SMI-49E	3	$43,500	1486	600	1000	1000	5.80		52	0.2	959	193	5014
EI-251A	3	$0	818	560	900	900		400kw	52	0.2	895	180	4683
EC-192A	2	$47,500	1200	800	1200	950	9.5		52	0.3	793	10	1009
WC-192A	2	$5,750	1200	800	1200	950	1.15		20	0.4	793	9	983
EC-33A	3	$7,500	818	750	1000	900	1.00		52	0.2	789	241	5847
EI-217 B	3	$20,250	840	715	1000	1000	2.70		52	0.2	752	230	5576
MP-138B	3	$0	736	450	1200	1200			52	0.2	719	145	3771
S.T148-D	2	$1,500	1200	700	700	800	0.30		35	0.3	694	9	874
HI-537	3	$57,990	818	645	1000	833	7.732		52	0.2	678	207	5034
VER-215 A/CF	3	$16,500	810	640	1000	1000	2.20		52	0.2	673	206	4996
WD-23	3	$0	600	409	900	900		275.00	50	0.2	654	132	3430
SS-157A	3	$0	818	610	1000	1000			50	0.2	642	196	4762
EC-192B	3	$7,500	818	600	900	900	1.00		52	0.2	631	193	4686
HI-537	3	$63,870	818	600	1000	780	8.516		52	0.2	631	193	4686
EI-182 A	2	$5,000	1200	625	1200	900	1.00		50	0.3	619	8	796
WD-152A	3	$0	750	375	900	900			35	0.2	599	121	3136
HI-531	2	$20,800	625	550	1200	1090	4.16		52	0.3	545	8	707
WC-192A	3	$12,000	818	500	1000	800	1.60		100	0.2	526	163	3953
WC-192-B	3	$12,000	818	500	1000	800	1.60		100	0.2	526	163	3953
WC-427A	3	$12,240	604	480	1000	812	1.63		52	0.2	505	155	3758
WC-522	2	$7,320	650	500	1200	1055	1.46		52	0.3	496	7	647
VR-398	3	$0	580	300	1200	900			52	0.2	479	98	2529
WD-24	3	$0	895	300	1000	1000		200.00	50	0.2	479	98	2527
SS-69	3	$0	818	450	900	900			50	0.2	501	145	3552
EW-947A	3	$0	818	400	900	900		300.00	50	0.2	446	129	3162
HI-471-A	3	$0	818	400	900	900			52	0.2	446	129	3163
SMI-147	3	$0	818	400	900	900			52	0.2	446	129	3163
SMI-147	3	$0	818	400	900	900			52	0.2	446	129	3163
SMI-160	3	$0	818	400	900	900			52	0.2	446	129	3163
ST-148E	3	$0	600	400	1200	1140			35	0.2	446	129	3149
BA-21	2	$5,000	430	400	1200	1000	1.00		52	0.3	446	6	575
EC-286A	1	$2,500	423	375	900	900	1.00		52	0.4	442	123	3017
	Units	**$624,083**	**47679**	**33216**	**51300**	**46380**	**96**	**1275**	**2560**	**49**	**43891**	**8323**	**218665**

5. Findings

This fleet analysis follows the Process Optimization Review (PRO-OP) study format as illustrated below:

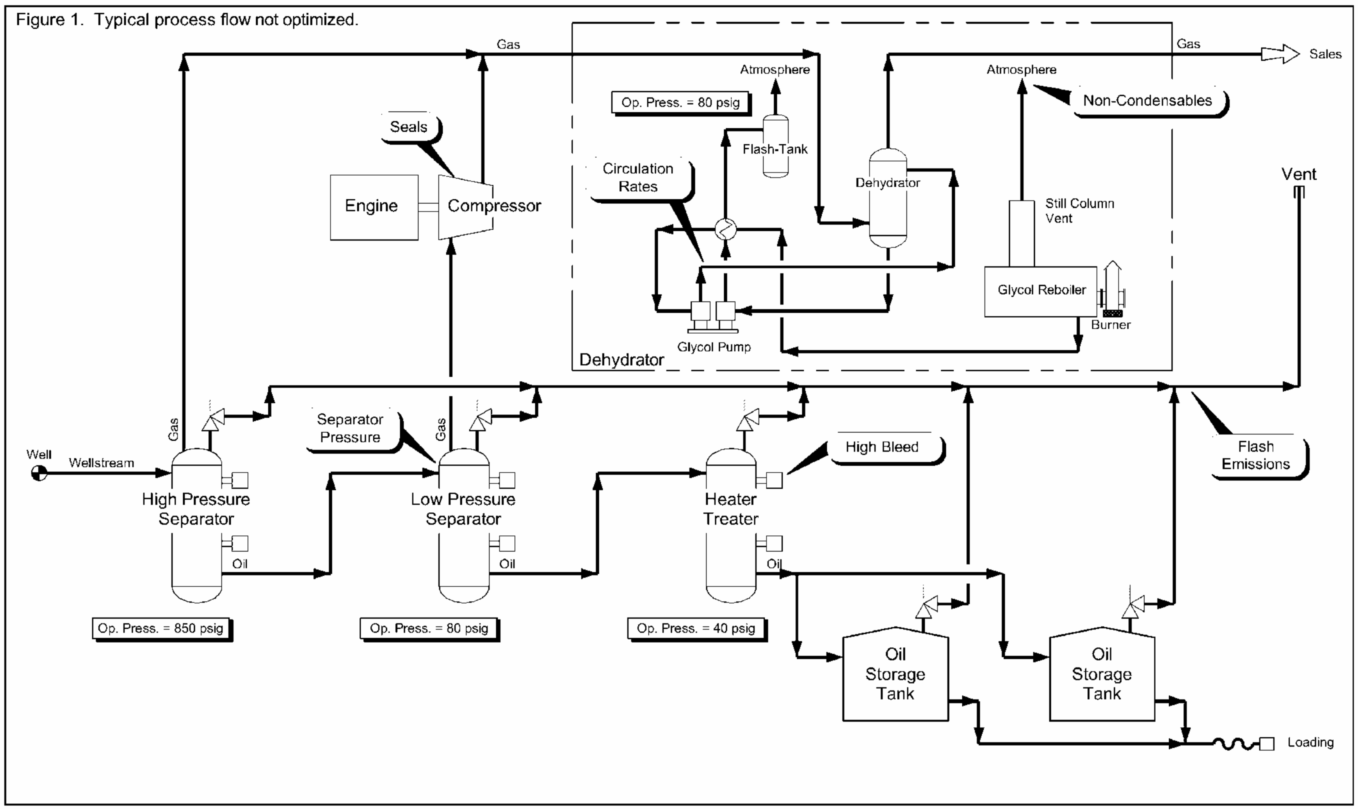

Figure 1. Typical process flow not optimized.

Wellhead →→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→Sales Gas Pipeline

Focus: Vent gas and fuel gas (methane) optimization

This Process Optimization Review (PRO-OP) process and this study attempts to identify the sources of the lost hydrocarbons (methane) and, more importantly, how to recapture them and thus optimize the process to increase Newfield's profits. As a consequence of this optimization, there is a significant opportunity to reduce green house gas emissions (GHG) such as methane.

The chart below summarizes the study's findings.

Hydrocarbons (Methane)	Source	Volume	Est. $ Value
I. Unburned (Based on 32 Facilities)	Routine venting	510,781 Mcf/yr	$4,059,372
II. Burned	Fuel gas (Total) PRO-OP Targets	921,649 Mcf/yr 751,501 Mcf/yr	$4,671,304 $3,809,336
	GHG Emission Reductions (eGHG in CO_2)	Total – 297,671 Tons/Yr PRO-OP – 218,665 Tons/Yr	

6. Observations and Conclusions

There is a significant opportunity for this E & P Natural Gas STAR producer to reduce his vent gas and fuel gas consumption. Using available technology, there is a good business case to proceed to the next phase of this project.

This project demonstrates that existing inventory databases such as GOADS contain information, which operators can use to implement their Gas STAR program and optimize their facilities. The GOADS database provides operators with the information to easily estimate emissions and rank facilities without conducting site visits to all locations. Based on the ranking, the operator can decide the facilities to conduct an onsite survey and measurement.

The methane estimates identified potential optimization targets. The ranking of facility methane emissions gives Newfield a list of locations to consider for onsite surveys and measurement. This information can be used to develop a plan for optimizing the processes, in a cost-effective manner, to increase the amount of natural gas injected into the pipeline. Reductions can be reported to the Gas STAR program. Optimizations reported to the Gas STAR program can be developed into a Lessons Learned.

This study project demonstrates that the objectives of the Natural Gas STAR Program of focusing on helping an oil and gas producer cost effectively reduce methane gas emissions as well as improve their profits is achievable.

Based upon the results and findings of this study, we suggest the following:

1. Target the highest payback facilities for on-site audits and inspections and establish baselines for current methane fuel gas consumption and emissions.
2. Conduct audits and inspections at selected facilities.
3. Pilot currently available technology; e.g. vapor recovery units, fuel optimization systems and compressed air/pneumatic low bleed options, focusing on the fastest payback opportunities.

By following the above sequence of actions, a baseline of before and after emissions of methane can be documented to analyze actual results versus expected results. The financial analysis and ROI/payback can be calculated and documented. Management will then have quantified business results upon which to base future investments.

Appendices

Appendix A

Flashing losses calculations for Glycol dehydrators and pressure and level controllers

Appendix B

Process Optimization (PRO-OP) Review: SPE Paper 93939

Appendix C –

Natural Gas Engines – Reducing Greenhouse Gases, White Paper
Howard Malm, PhD